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Evaluation of cracks associated with ultrasonic root-end preparation

Layton CA, Marshall JG, Morgan LA, Baumgartner JC. Evaluation of cracks associated with ultrasonic root-end preparation. J Endodon 1996;22:157-60.

PURPOSE: To evaluate resected root-end surfaces of bilaterally matched human teeth for cracks before and after root-end preparation using ultrasonic tips at low or high frequencies.

M&M: 30 bilaterally matched pairs of single-rooted teeth were used. 3-mm root-end resections were made perpendicular to the long axis of the root using a diamond wafering saw. The teeth were placed in scintillation jars with 0.004% methylene blue in distilled water and were examined 48-h later. Presence, location, and number of cracks were recorded and the teeth were placed back into the jars. One of each matched pairs was placed into one of two groups. In the first group, class I cavity preps to a depth of 3 mm were prepared in the root ends with EIE tips at the lowest frequency setting; in the 2nd group, the highest frequency setting was used. Preparation time was < 2 min. The teeth were placed back into methylene blue and then re-examined for cracks, and differences between the numbers and types of cracks seen after root resection and root-end prep using ultrasonics at low and high frequencies were statistically analyzed.

RESULTS: Three types of cracks were observed on resected root ends: canal, intradentin, and cemental cracks. Some cracks were observed in some teeth after root resection but before root-end prep, while additional cracks occurred after root-end prep. Many teeth did not have any cracks visible at any time. A significantly greater number of teeth had canal cracks after ultrasonic root-end prep than after root resection only. When cracking occurred in a tooth, high-frequency ultrasonic root-end prep resulted in a greater number of canal cracks per tooth than did low-frequency prep.

CONCLUSIONS: Although both complete and incomplete cracks were found following ultrasonic root-end preps, what effects they may have on ultimate prognosis is uncertain, and we do not have comparable studies on the effects of sonic instrumentation or the use of burs on dentinal or canal cracking during root-end prep. Nevertheless, if high-frequency ultrasonic root-end prep does result in significant cracking of dentin and/or cementum *in vivo*, there may be cause for concern.

April 1996 **Michael Hall**

Histological response to titanium endodontic endosseous implants in dogs

Parreira FR, Bramwell JD, Roahen JO, Giambarresi L. Histological response to titanium endodontic endosseous implants in dogs. J Endodon 1996;22:161-4.

PURPOSE: To evaluate histologically the healing response to the placement of titanium endodontic endosseous implants in dogs.

M&M: Two dogs were surgically anesthetized. Experimental maxillary central incisors and mandibular 1st premolars were isolated, endodontically accessed, and prepared in a step-back fashion. The apical root and osseous tissues were prepared with a guide drill, 3-4 mm past the root apex. Eight parallel, threaded, titanium implants (Park Dental) were cemented with AH26 cement, using a twisting motion. Accesses were sealed with amalgam. Periapical radiographs were exposed at 1, 30, 90, and 180 days after treatment. 6 months after treatment, the dogs were killed, and block sections of the implants and involved teeth were prepared for light microscopy.

RESULTS: The dogs experienced no adverse clinical sequelae. Radiographically, there were no periradicular changes observed; no osseous changes were noted along the length of the implants. Histologically, the implants seemed well tolerated. Generally, fibrous connective tissue and healthy bone were intimately associated with the implant surfaces. No osteoclastic activity was associated with the bone surrounding the implants. There was virtually no chronic inflammatory response or epithelial proliferation, either at the root apices or along the length of the implants.

C&C: The authors seem to be trying to revitalize clinician confidence in endodontic implants, and rekindle research into development of new systems. They claim that use of endodontic implants has waned, in part due to the recent focus on failed cases, which were attributable to poor case selection. The authors have shown short-term histological tolerance of a few titanium implants, when placed into healthy, nonfunctional teeth and tissues of dogs. None of these conditions duplicate the pathological conditions in which an endodontic implant would be placed clinically, or the long-term clinical requirements. Indeed, those conditions which are the indications for endodontic implants may ultimately contribute to their failure.

April 1996 **Christopher F. Bates**

Sealing ability of a new hydroxyapatite-containing endodontic sealer using lateral condensation and thermatic compaction of gutta-percha, in vitro

Gambarini G, Tagger M. Sealing ability of a new hydroxyapatite-containing endodontic sealer using lateral condensation and thermatic compaction of gutta-percha, in vitro. J Endodon 1996;22:165-7.

PURPOSE: To evaluate the sealing ability of Bioseal and to compare it to that of Pulp Canal Sealer (PCS) using 2 obturation techniques.

M&M: The roots of 42 extracted teeth were separated from their crowns and the canals prepared in a standardized fashion. The roots were randomly assigned to 4 groups of 10, with 2 controls. Bioseal and PCS sealers were prepared, and the teeth of two groups were filled by LC with either Bioseal (group A) or PCS (group C). The other 2 groups were filled by the thermomechanical compaction (TC) method described by McSpadden; in group B, Bioseal was used and in group D, PCS was used. The specimens were stored to allow sealer to set and then the apical 2-3 mm were placed in methylene blue for 7 d. The apical 6 mm of the roots were then sectioned horizontally at 1-mm intervals and examined for dye leakage.

RESULTS: Average dye penetration in group A was 1.1 mm (Bioseal, LC); group B was 1.5 mm (Bioseal, TC); group C was 1.4 mm (PCS, LC); and group D was 1.4 mm (PCS, TC). There were no statistically significant differences in leakage between any 2 of the 4 experimental groups.

C&C: Bioseal powder is composed of 16% HA, 20% barium sulfate, 4.2% di-iodothymol, 16.4% natural resin, and 43.4% zinc oxide and calcium hydroxide; the liquid consists of 78% bi-distilled eugenol and 22% purified oleoresin. PCS is a conventional ZOE-type sealer. Two areas of concern regarding Bioseal were studied: whether the inorganic HA filler would allow capillary leakage among the particles, and the short setting time, which might be insufficient for complete condensation of GP. The results of the study seemed to indicate that the composition of Bioseal did not compromise the quality of the seal as indicated by minimal leakage. What potential benefits or effects HA may have as an ingredient in the sealer were not studied.

April 1996 **Michael Hall**

Characteristics and effects of calcified degenerative zones on the formation of hard tissue barriers in amputated canine dental pulp

Higashi T, Okamoto H. Characteristics and effects of calcified degenerative zones on the formation of hard tissue barriers in amputated canine dental pulp. J Endodon 1996;22:168-72.

PURPOSE: To study the presence, ultrastructural features, and contribution of the degenerative zone beneath the necrotic zone, and whether it has effects on the formation of reparative dentin.

M&M: 40 teeth from 4 dogs were pulpally amputated at the canal orifice, and dressed with a calcium hydroxide paste. Cavities were sealed with both ZOE and zinc phosphate. The animals were killed 1, 3, 7, and 14 d after pulpotomy. Teeth were carefully cracked open, and the undecalcified pulps were dissected free. Thick sections were stained for phosphate (von Kossa method) visualization under light microscopy (LM). Ultrathin sections were examined by electron microscopy (EM), and by electron probe microanalysis for calcium and phosphorus.

RESULTS: Day 1 - minute von Kossa-positive granules (LM) and membrane-bound bodies (EM) were seen under the zone of necrosis. These changes were indicative of incipient calcification. Day 3 - a distinct layer of more von Kossa-positive granules lined the amputated pulp, as did multi-shaped electron-dense bodies (similar to day 1). Day 7 - all sections showed the same von Kossa-positive granular layer and electron-dense deposits seen earlier; these deposits contained calcium and phosphorus. Day 14 - most sections exhibited hard tissue barrier formation beneath the von Kossa-positive granular layer. The hard tissue barriers were of two morphological types: (a) tubular dentin associated with a layer of von Kossa-positive granules; and (b) osteodentin beneath the von Kossa-positive zone, with tubular dentin below.

C&C: In this highly descriptive, observational analysis, the authors essentially conclude that the von Kossa-positive granular layer (which they termed the dystrophic calcified zone) has some important effect on the reparative process of the pulp tissue after pulpotomy. What this role is, they do not speculate; however, wound healing (with tubular dentin) definitely progressed more rapidly and completely when the dystrophic calcification zone was more uniform.

April 1996 **Christopher F. Bates**

Comparison of radiographic and electronic working lengths

Pratten DH, McDonald NJ. Comparison of radiographic and electronic working lengths. J Endodon 1996;22:173-6.

PURPOSE: To compare the ability of an apex locator and a radiograph to determine accurately and reliably the endodontic working length.

M&M: 27 root canals from six cadavers were used in this study. Preop xrays were exposed using D-speed film. The electronic termination points for each canal were then determined using an Endex apex locator. The termination point used was the meter's red line designated as the "Apex," a point slightly beyond the apical constriction (AC). A #15 file was placed in the position designated by the apex locator, fixed in place with composite resin, and 3 parallel radiographs at different horizontal angles were exposed. Five endo residents evaluated the WL xrays (yikes!), and the positive or negative deviation of the file tip from the AC was then measured for each canal with an optical microscope. The Endex red line measures the location of the apical foramen, so 0.5 mm had to be subtracted from the AC deviation measurement as recommended by Osada Electric. This value was designated the apex locator deviation (ALD); the average radiographic adjustment determined from examination of the xrays was added to the ALD to obtain the radiographic method deviation (RMD).

RESULTS: The most frequent response for the ALD was 0.0 mm, while that for the RMD was –0.5 mm (short of the AC).

CONCLUSIONS: The apex locator in this study was quite reliable in determining the location of the AC. Only 3/27 readings deviated more than 0.5 mm, and there were no deviations greater than +1.0 mm. The radiographic method was less reliable and tended to underestimate the WL. This study utilized cadaver specimens, so whether vital tissue impedance would have made a difference is unknown. Also, one-third of the canals used were from man premolars, not a representative tooth sample, so the results may have been skewed by not using teeth whose AC's are more difficult to interpret, such as max molars. In any event, apex locators remain an important adjunct in proper WL determination.

April 1996 **Michael Hall**

Comparison of stainless steel and nickel-titanium instruments in molar root canal preparation

Samyn JA, Nicholls JI, Steiner JC. Comparison of stainless steel and nickel-titanium instruments in molar root canal preparation. J Endodon 1996;22:177-81.

PURPOSE: To compare the centering ability of stainless steel (SS) and nickel-titanium (NT) K-type files following complete instrumentation in curved molar canals. Also assessed for the two file types were the canal area change and final preparation shape.

M&M: 40 mesial roots from human molars were divided into two similar curvature groups, embedded in clear polyester resin, and sectioned at apical and height of curvature locations. Each group of roots was instrumented using a step-back filing technique, with either precurved SS files (Zipperer) or noncurved NT files (Quality Dental). Apical seats were prepared to size #30 at WL using a "stem-winding" motion, and #2 and #3 Gates Glidden drills were used coronal to the curve. Pre- and postinstrumentation photographic images from the sectioning locations were traced, and analyzed for extent of canal center movement, difference between original and final canal area, and determination of final shape.

RESULTS: There was no significant difference in canal movement between the SS and NT groups at either canal level (< 0.2 mm for each). All movement was toward the furcation area at the height of curvature and away from the furcation in apical sections; no correlation was found between curvature and this movement. The mean pre- and postinstrumentation canal areas of each group were also not significantly different, nor was there any significant area difference between the groups. The majority of canal shapes for both SS (53%) and NT (68%) were oval.

C&C: It was reasonable to assume that the more flexible, NT files would conform better to canal curvature with less movement of the canal center during instrumentation. The NT group did not outperform the SS group in this investigation, however. Perhaps the lack of difference was due to the gradual degree of curvatures examined (range 20-35º), and the small master apical file size studied (#30). Such limited study conditions do show that the relatively flexible, #30 SS files perform similar geometrical wall cutting as NT files in lightly curved canals. Significant differences would be more likely in cases adequately prepared apically (size #35 or higher), and with greater degrees of curvature.

April 1996 **Christopher F. Bates**

Use of an electronic apex locator on a cardiac pacemaker patient

Beach CW, Bramwell JD, Hutter JW. Use of an electronic apex locator on a cardiac pacemaker patient. J Endodon 1996;22:182-4.

PURPOSE: To present a case in which an EAL was used on a patient with his cardiologist's consent, despite the manufacturer's advice to avoid doing so.

CASE REPORT: A 54-yr-old male who had had a pacemaker for over 20 yr presented with severe pain UR. The offending tooth was determined to be #5 with a necrotic pulp and an acute periradicular periodontitis. The patient was premedicated with Amoxicillin per his cardiologist's instructions, and RCT initiated. The apices of the two roots were difficult to radiographically interpret, so before the next appt, the cardiologist was contacted and given a description of the EAL's function. Since the patient had an older fixed rate pacemaker and an escape heart beat, the cardiologist approved the use of the EAL, since its voltage (9V) and current were not high enough to affect the pacemaker (the patient would still have an underlying functional heart beat even if the pacemaker totally shut off). Treatment continued using the EAL for length determination.

DISCUSSION: The newer demand pacemakers do not interfere with or compete with the patient's inherent heart rhythm, unlike older fixed rate pacemakers which stimulate the heart regardless of the heart's own rhythm. Unfortunately, the demand pacemakers are more sensitive to electrical disturbances which can occur through the use of pulp testers, EALs, electrosurgical instruments, ultrasonic instruments, and current leakage from operatory electrical equipment. Use of a magnet to temporarily convert a demand to a fixed mode can be accomplished to allow for safe patient treatment, but this can only be done in a hospital setting with resuscitative equipment readily available. In the case reported, the patient had a fixed rate pacemaker, which reduced the risk of using an EAL, which the authors did after consulting the patient's cardiologist.

April 1996 **Michael Hall**

Long-term follow-up on C-shaped mandibular molars

Ricucci D, Pascon EA, Langeland K. Long-term follow-up on C-shaped mandibular molars. J Endodon 1996;22:185-7.

CASE REPORTS: (1) A vital pulp emergency of tooth #18 led to endodontic therapy. Only one ML canal and a C-shaped fissure-like canal (with its concavity toward the L) connecting the D to the MB were found. Whenever an instrument was inserted into any side of the C-shaped canal, it always ended in the distal foramen of the tooth, and a file introduced in this canal could probe the whole extension of the C. Canal instrumentation was performed to within 1-1.5 mm from the radiographic apex using 1% NaOCl, after which calcium hydroxide was placed for 7 d. The lone ML canal was obturated first, with GP and Rickert's sealer. The excess GP was removed to make enough space to then fill the C-shaped canal. Healing of the periapical tissue was complete at 3 yrs. (2) A pulpally necrotic #31 presented, with similar internal anatomy to case #1. The canals were completely cleaned and shaped, and filled with calcium hydroxide. After 10 d, the pt was asymptomatic, and the canals were obturated. Complete radiographic healing had occurred by 3 yrs. (3) A previously endodontically treated #31, presented in pain with grade 3 mobility and pockets > 10 mm. The tooth was extracted, and exhibited: a single root with a C-configuration; a L-concavity covered by calculus; and external apical resorption. Radiographs showed root canal treatment performed as if it involved a normal lower molar. The cavity floor showed three orifices filled with GP; however, the C-shaped canal morphology was confirmed in all sections made at deeper levels. A fissure containing necrotic debris connected both mesial canals to the distal.

DISCUSSION: No case has been previously described of a C-shaped canal which courses toward the distal, and terminates in a narrow apical foramen. Also, most previously reported C-shaped canals have been found in molars that radiographically showed separated mesial and distal roots. In two of the cases here, there was a single conical root.

April 1996 **Christopher F. Bates**